MECHANICAL ENGINEER

NUMERICAL AND EXPERIMENTAL STUDY OF THE PERFORMANCE OF A DROP-SHAPED PIN FIN HEAT EXCHANGER

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This research presents the results of a combined numerical and experimental study of heat transfer and pressure drop behavior in a compact heat exchanger (CHE) designed with drop-shaped pin fins. A numerical study using ANSYS was first conducted to select the optimum pin shape and configuration for the CHE. This was followed by an experimental study to validate the numerical model.

The results indicate that the drop shaped pin fins yield a considerable improvement in heat transfer compared to circular pin fins for the same pressure drop characteristics. This improvement is mainly due to the increased wetted surface area of the drop pins, and the delay in the flow separation as it passes the more streamlined drop shaped pin fins. The data and conclusions of this study can be used in heat exchanger design for large heat flux cooling applications, such as gas turbine blades and high-power electronics

KEYWORDS: Pin-Fin Array, Compact Heat Exchanger, Drop-Shaped Pin Fins, Heat Transfer, Pressure Drop, Micro Heat Exchanger, Turbine Blade Cooling, High Power Electronics Cooling

PREDICTION OF SURFACE SHIP RESPONSE TO SEVERE UNDERWATER EXPLOSIONS USING A VIRTUAL UNDERWATER SHOCK ENVIRONMENT

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During World War II, many surface combatants were severely crippled by close-proximity underwater explosions from ordnance that had actually missed their target. Since that time, in order to test the survivability of mission essential equipment in a severe shock environment, all new classes of combatants have been required to have shock trial tests conducted on the lead ship of the class. While these tests are extremely important in determining the vulnerabilities of a surface ship, they require an extensive amount of preparation, manhours, and money. Furthermore, these tests present an obvious danger to the crew onboard, the ship itself, and any marine life in the vicinity.

Creating a virtual shock environment by use of a computer to model the ship structure and the surrounding fluid presents a valuable design tool and an attractive alternative to these tests. This thesis examines the accuracy of shock simulation using the shock trials conducted on *USS WINSTON S. CHURCHILL* (DDG 81) in 2001. Specifically, all three explosions DDG 81 was subjected to are simulated and the resulting predictions compared with actual shock trial data. The effects of the fluid volume size, mesh density, mesh quality, and shot location are investigated.

KEYWORDS: Underwater Explosion, Modeling and Simulation, Shock and Vibration, Ship Shock, Virtual Environment, UNDEX, Shock Measurement